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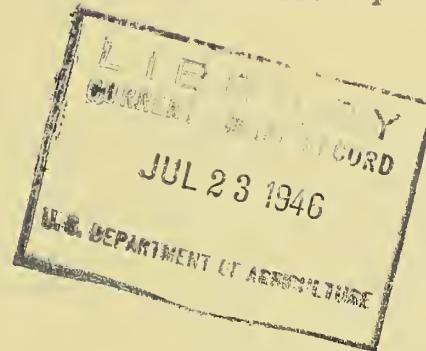
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Soils, and Agricultural Engineering

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REPORT ON SHIPPING TEST WITH FROZEN PRECOOKED FOOD
JERSEY CITY, N. J. TO OAKLAND, CALIF.
SEPT. 20 to OCT. 4, 1945

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Report on Shipping Test With Frozen Precooked Food
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The present test is a part of a larger project to ascertain the relative merits of refrigerator cars of various designs for the shipment of frozen foods. The commodity in the test consisted of precooked "flight meals". These individual meals had been placed on covered fiberboard plates and frozen at -10° F. They were being shipped to the Naval Supply Depot, Oakland, Calif., to be placed in storage for later shipment by boat to Pacific bases. They were for use of plane crews aloft, after being heated.

Refrigerator Cars:

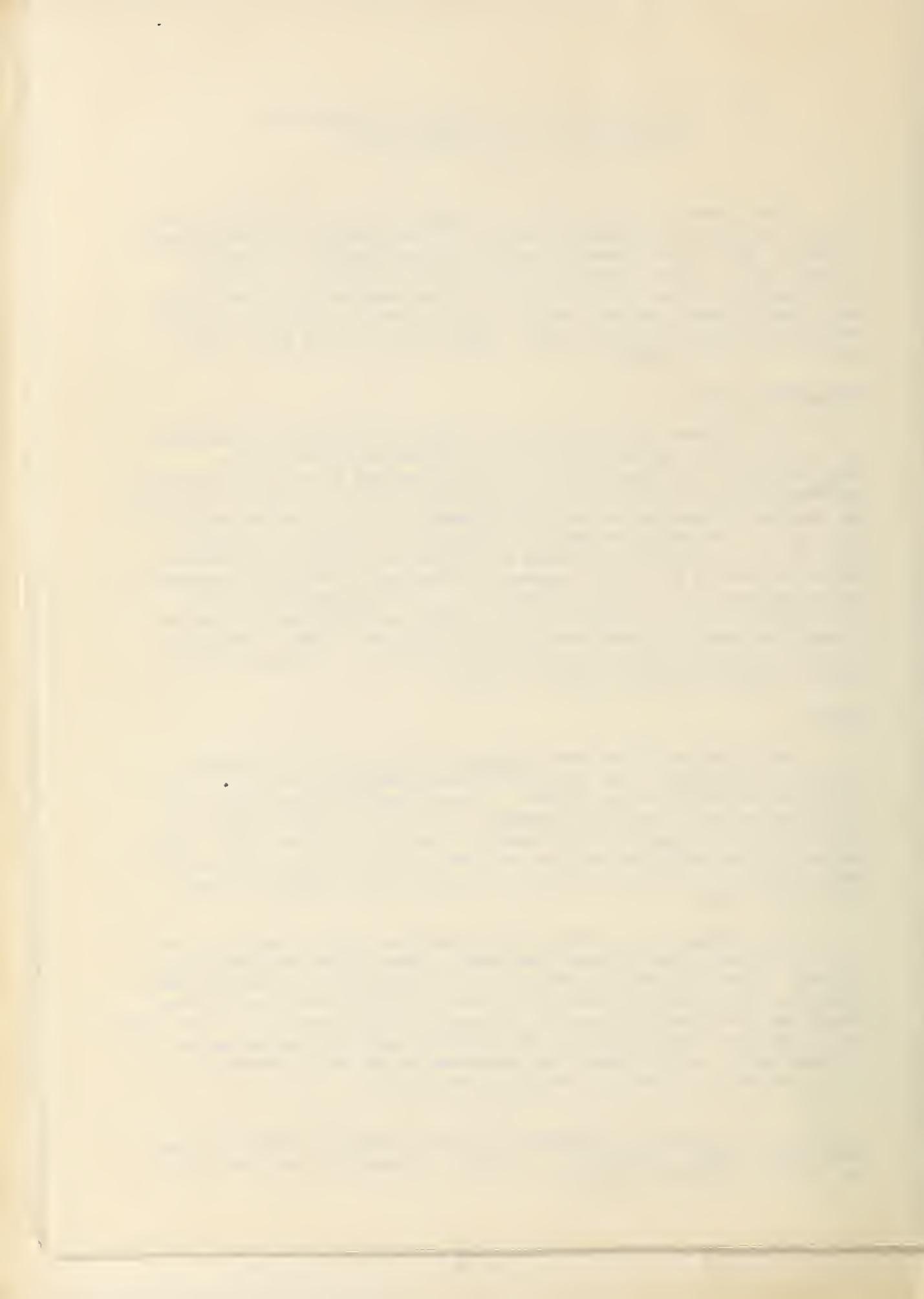
The two cars compared were an overhead brine-tank car, FOBX 4982, and an end-bunker fan car, SFRD 5066. Both had heavy insulation; FOBX 4982 had 6" of insulation in sides and end and 8" in floor and roof, and SFRD 5066 had 6-1/4" in sides and ends, 7-1/4" in roof and 7" in floor. The overhead bunker car had an inside length of 50 ft., inside width of 8 ft. 8 in., and inside height from floorracks to ceiling at sidewall of 6 ft. 10 in. The inside length of the fan car was 42 ft. 1-3/4 in., inside width of 8 ft. 11 in. (permanent stripping on sidewalls decreased the lading space to a width of 8 ft. 8 in.), and inside height above floorracks 7 ft. 1 in. The floorracks were 6 in. in height and the fans at each end under the racks were 6 in. in diameter. (Note: The more recently installed fans have a diameter of 7-1/2 in. and deliver about twice as much air as the older 6 in. fans).

Loads:

The flight meals had been packaged in two sizes of corrugated fiberboard containers. One size had outside dimensions of 21-1/4 in. by 21-1/4 in. by 16-1/4 in. in height. It contained 48 flight meals, each in a moisture-proof cellophane envelope. The gross weight of each of these packages averaged about 50 pounds of which 33 lbs. was food. The smaller package contained half as many meals as the larger. Its dimensions were 21-1/4 in. by 11 in. by 16-1/4 in. and its gross weight averaged about 25-1/2 lbs.

The packages were loaded offset crosswise with 4 large and 1 small package in each of the 4 layers per stack. Some stacks were composed entirely of small packages. The fan car contained 368 large and 92 small packages. The billing weight of the load was 20,717 lbs. The overhead bunker car contained 324 large and 340 small packages and the billing weight was 24,285 lbs. Thus because of the greater length of loading space, the overhead bunker car contained the equivalent of 80 large packages or a billing weight of 3,568 lbs. more than the fan car.

1/ The test was made in cooperation with the Provisions Officer of the Naval Supply Depot, Bayonne, N. J., the W. L. Maxon Co., and the carline and railroad companies involved.



The top of the load in the fan car was about 22 in. below the ceiling and about 9 inches below the bottom of the top bunker openings. In the overhead bunker car the top of the load was about 19-1/2 in. below the ceiling at the side walls.

At the request of the shipper the floorracks and the top of the load were covered with heavy kraft paper. The cars were loaded from the platform of a freezer warehouse. All the packages had been held overnight in the warehouse at -4° F.

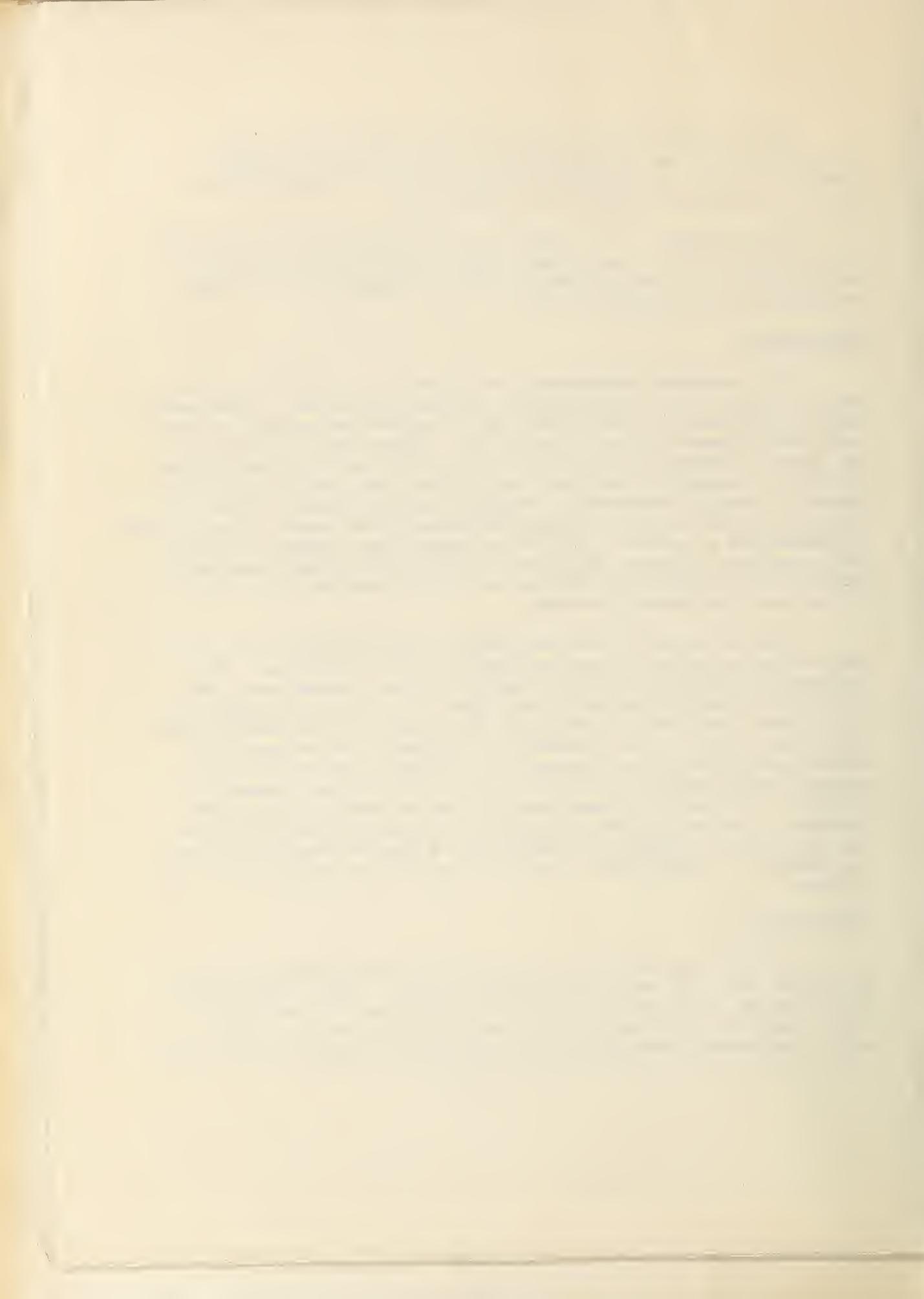
Thermometers:

Ryan recording thermometers were placed at 6 locations in each car and on the outside underneath the overhead bunker car. These instruments were adjusted to record about 20° F. higher than normal, because their normal range does not go below zero. Before being placed in the car these instruments were held at -4° F. for 48 hours for calibrating. At this low temperature the ink froze and the clock mechanism failed to operate in several instruments. However, they were placed in the load anyway on the chance that the temperature might rise enough during transit to enable them to operate. This is the reason why a number of records are incomplete. However, sufficient temperature data were recorded to afford a good comparison of the two cars within the limits of accuracy of the recording thermometers used.

Ryans to record top air temperatures were attached to the ceiling near the centerline at the quarterlength position in each car. The instruments to record bottom air temperature were fastened under the floorracks directly below the top-air Ryan. To record the temperature of the load, Ryans were placed inside the packages at the quarterlength, centerline position. The instrument was placed in the bottom of the bottom layer package (bot. quarter), in the top of the second layer package (middle quarter) and in the top of the top layer package (top quarter). To record the temperature at what is probably the warmest location in the car, a Ryan was placed in the top of a package in the top layer next to the door (top doorway). A Ryan was also attached to the underside of FOBX 4982 to obtain a record of the outside temperature en route.

Refrigeration:

The bunkers of each car were filled to capacity with a mixture of 30 percent salt with ice 1/8 hours before loading. The overhead bunkers took 9,000 lbs. of crushed ice and 2,700 lbs. of salt. The bunkers of the fan car were filled with 15,000 lbs. of coarse ice and 4,620 lbs. of salt. The bunkers were reiced with the ice-salt mixture 24 hours before loading and again immediately after loading.



Records taken with hand thermometers just before loading showed air temperatures of 11° and 10° F., respectively, at the floor and near the ceiling of the overhead bunker car and 11° and 18° respectively, at the same positions in the fan car. During the preloading period the cars remained stationary most of the time. At the shipper's request 10 packages of solid carbon dioxide, each weighing approximately 43 lbs. were scattered over the top of each load. Care was taken not to have any of this ice near the top layer thermometers.

Both cars were billed under standard refrigeration with 30 percent salt. They were routed D. L. & W., Wabash, U. P., and S. P.

RESULTS OF THE SHIPPING TEST

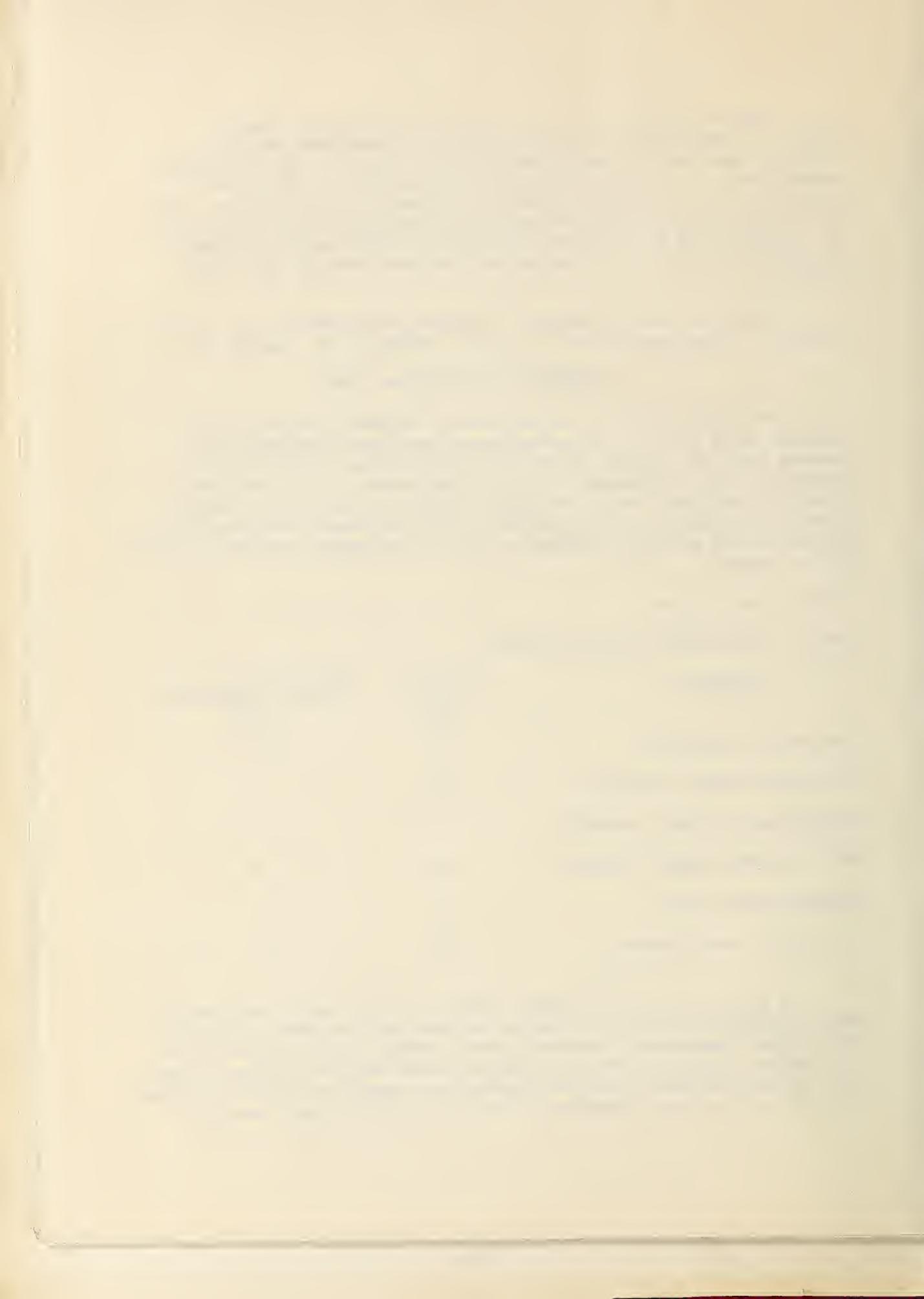
The cars arrived in the Bay Area on October 2 but were not unloaded until Oct. 4. The packages and the Ryan thermometers were removed from the cars and placed in a freezer room at 5° F. At this temperature the instruments were again calibrated. Each Ryan was examined immediately on arrival and a record was made of the temperatures it indicated so that readings of arrival temperatures were obtained for all positions whether or not the instrument involved operated during transit.

Transit temperatures:

Arrival temperatures were as follows:

<u>Position</u>	<u>Fan car</u> ° F.	<u>Overhead bunker car</u> ° F.
Top doorway commodity	17	11
Top quarterlength commodity	18	-
Middle quarterlength commodity	4	5
Bottom quarterlength commodity	10	8
Top air quarterlength	13	9
Bottom air quarterlength	8	8

A graphic record of transit temperatures for those positions in which complete records were obtained in both cars is given in Figure 1. The highest temperature recorded in the overhead bunker car was at the top doorway position a few hours before unloading. The highest in the fan car was recorded at the top quarterlength position at time of unloading. In general the temperature of this top quarterlength position



during transit was similar to that at top doorway shown in the graph. The high temperatures recorded initially at the top doorway position were due to the delay in loading these packages as well as to the delay in cooling at this point, after the doors were closed. This emphasizes the importance of rapid loading and a quick transfer of packages from the freezer to the refrigerator car. The transit records together with those noted at arrival indicate that the average transit temperature for the overhead bunker car was 3° or 4° F. lower than that for the fan car. As may be seen in Figure 1 the packages at the top doorway of the overhead bunker car remained fairly constant at about 10° F. throughout the trip. Likewise the bottom quarterlength packages were fairly constant at about 7° F. In the fan car the fluctuations in the temperature of the top doorway packages were considerably greater. These fluctuations were due to the fans which operated only as the car moved and were inactive when the car was stationary. As may be seen, the direction of change in the temperature of the bottom air was the reverse of that of the top doorway. Unfortunately the outside air thermometer recorded for 9 days only.

Condition of packages:

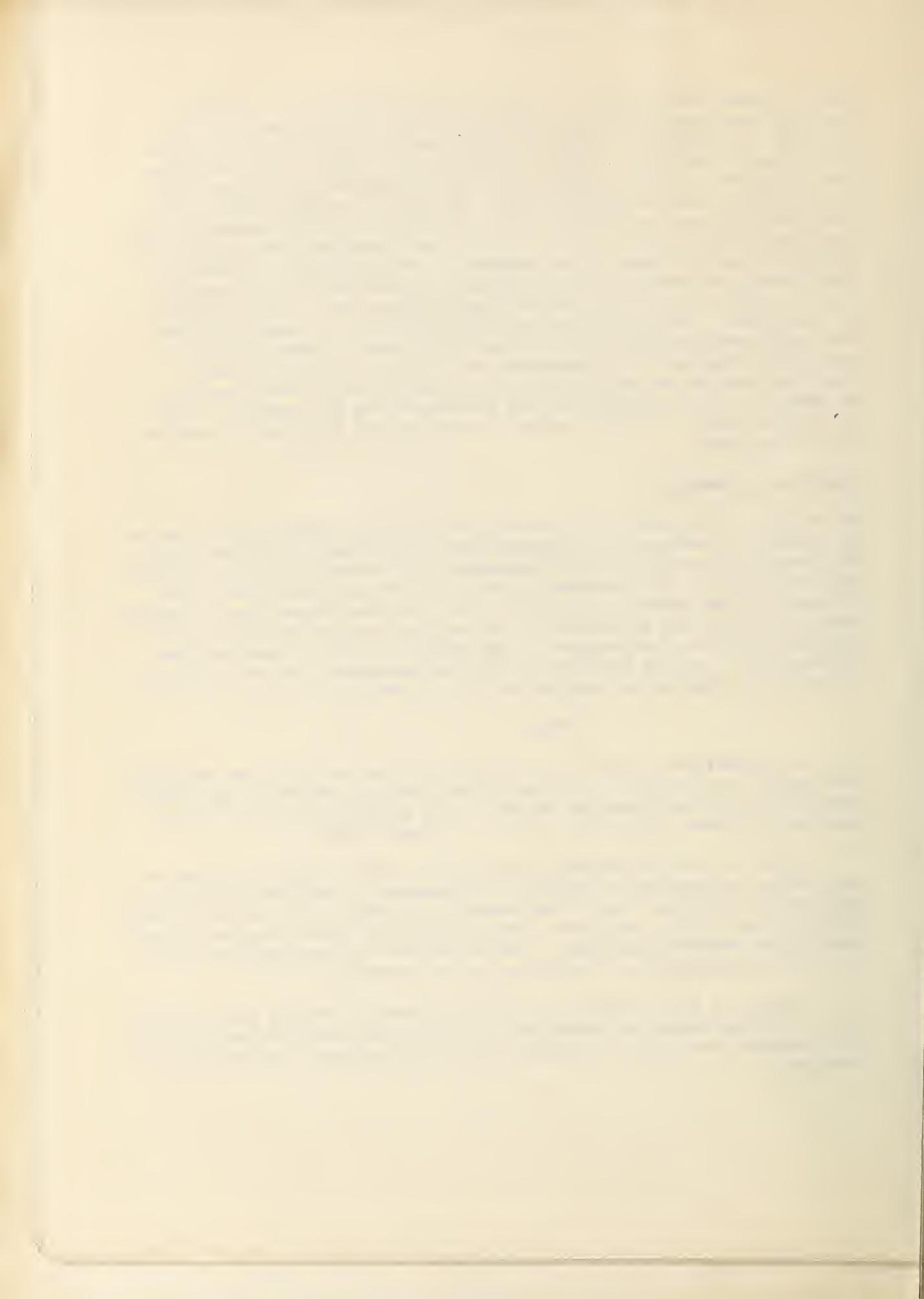
No thawing of food was noted in either car when the packages were examined at unloading. Because of the temperatures maintained this frozen condition would be expected since the prepared food is said to begin to soften only above 25° F. The packages in the top layer and those against the sidewalls of the overhead bunker car were moist and slightly out of shape. During the unloading period heavy condensation of water occurred on the ceiling of this car and dropped on the packages below, moistening them considerably. The wet packages in this car detracted from the appearance of the load. The fan car was better in this respect.

SUMMARY

A comparison was made of an overhead bunker car and a car equipped with fans of old design (6 in. fans), both heavily insulated, refrigerated with a 30 percent salt and ice mixture, in a shipping test with frozen prepared food from Jersey City, N. J. to Oakland, Calif.

The food in both shipments was found solidly frozen on arrival at destination, indicating satisfactory performance of refrigeration in both types of car. During transit the commodity temperature in the cars ranged between 4° and 18° F., with the average 3° or 4° F. higher in the fan car than in the overhead bunker car. The temperature of the commodity showed a narrower range and less fluctuation in the latter car.

There was some condensation and drip from the ceiling and sidewalls of the overhead bunker car which wet a considerable number of packages and this detracted from their appearance, but their contents remained dry and undamaged.



An extra layer of packages could have been loaded in the overhead bunker car but not in the fan car because it would have blocked the top bunker openings. Whether the extra layer could have been carried safely in the overhead bunker car remains a question; there would have been a clearance of only about 3" at the top which might have resulted in impeded air movement or other disadvantages.



FIGURE 1. TRANSIT TEMPERATURES OF AIR AND PRECOOKED FROZEN FOOD
SHIPPING TEST JERSEY CITY, N. J. TO OAKLAND, CALIF.

